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APPARATUS AND METHOD FOR MAINTAINING THE PERMEABILITY OF PAPER  
AND BOARD MACHINE FELTS. ;

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NZ194626, ZA8004983

**ABSTRACT:**

A method of maintaining the permeability of felts (1) in paper board and like machines comprises the steps of monitoring the permeability of the felt (1), and bringing into operation apparatus (5) for directing at the felt a spray of liquid for reconditioning the felt (1), when the monitored permeability monitored by means (11) reaches a first predetermined value and terminating the operation of the apparatus when the permeability reaches another second predetermined value higher than the first value.

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# EUROPEAN PATENT APPLICATION

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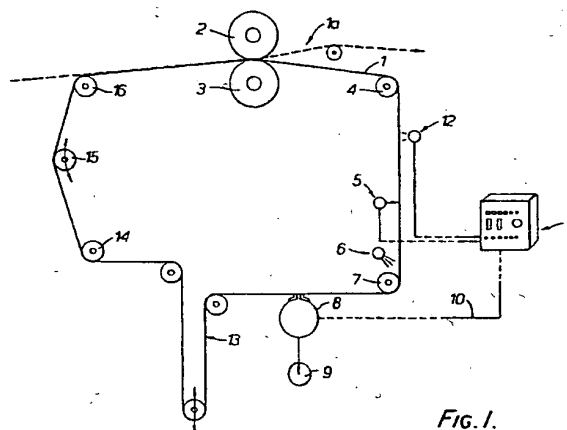
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54 Apparatus and method for maintaining the permeability of paper and board machine felts.

57 A method of maintaining the permeability of felts (1) in paper board and like machines comprises the steps of monitoring the permeability of the felt (1), and bringing into operation apparatus (5) for directing at the felt a spray of liquid for reconditioning the felt (1), when the monitored permeability monitored by means (11) reaches a first predetermined value and terminating the operation of the apparatus when the permeability reaches another second predetermined value higher than the first value.



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Apparatus and method for maintaining the permeability  
of paper and board machine felts

This invention relates to apparatus and to methods of maintaining the permeability of paper and board machine press felts.

Such machines employ press felts to transport the  
5 raw paper or board and to accept water pressed from the raw material during the manufacture of paper and board in the press section of machinery for making paper, board and asbestos/cement sheets and in the so-called "making" section of machines for making asbestos/cement sheets.

10 All press felts will compact in use to an extent related to their design, compressibility, length, press loading speed and contamination.

As they compact the ability of the felt to accept water and to allow water passage through its structure  
15 reduces, and this reduces the ability of the felt to receive contaminants because the compaction reduces the available volume in the felt between the interstices thereof.

Thus, the condition of the felt continuously deteriorates throughout its life and its efficiency gradually  
20 reduces. To overcome this, the present method is to use a high-pressure needle-jet shower, operating at a pressure of say  $35 \text{ Kg/cm}^2$ , whose high energy jets of water loosen the contaminants and rebulk the felt. The high pressure is needed, to be effective, but the use of the shower is usually  
25 discontinuous, say 30 minutes per shift, for if operated continuously the structure of the felt would be damaged. The current system incorporates an intermittent high-pressure,

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needle-jet, oscillating shower, to rebulk the felt, a continuous, low-pressure fan shower to wash out the contaminants, and a vacuum box to remove contaminated water from the felt.

- 5 All felts have their particular felt/water ratio maximums, i.e. saturation, and minimums, i.e. through vacuum extraction, and they operate within those limits, to accept water pressed out of the paper or board sheet. If the ratio is high then the low pressure fan shower is often not used
- 10 because there is enough water to act as a contaminant transport for the vacuum box. However, the high-pressure, needle-jet shower must be incorporated to maintain the bulk and the vacuum box must be incorporated to remove the water from the paper.

- 15 It is an object of the present invention to ensure that the high pressure shower is used effectively to maintain the felt in good condition and so prolong its working life and to ensure efficient water extraction.

- According to the present invention a method of main-
- 20 taining the permeability of a felt in a paper, board or like machine comprises the steps of monitoring the permeability of the felt during operation of the machine and directing at the felt a stream of reconditioning liquid when the monitored permeability reaches a first predetermined value and
- 25 terminating the stream when the permeability returns to a second predetermined value higher than the first value.

- Using a constant volume vacuum source, as is common, to draw water/air through the felt through a slotted or drilled top, on a vacuum box, the vacuum level in the box
- 30 becomes a measurement of resistance to flow. This resistance directly relates to the condition of the felt and to its bulk or compaction and contamination and one method according to the present invention is based upon the use of a vacuum level as a signal to control apparatus sensitive to
- 35 preset minimum/maximum vacuum levels for optimum felt condi-

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tion. When the maximum level is reached, the high pressure needle jet shower will be activated. When the minimum level is reached, the shower is shut down. This is repeated throughout the felt life.

- 5 Typically, the system would not activate in the first 2-3 days of a felt's life, then it would commence and increase, for say 80% of the expected life, then reduce because of the effect of felt wear.

As has been stated above, the felt tends to compact  
10 during use and, therefore, the thickness of the felt also characterises its permeability.

Thus, in another method according to the invention, monitoring of the permeability is effected by monitoring the thickness of the felt and bringing into operation the  
15 stream of reconditioning liquid when the thickness reaches a predetermined first value and terminating the stream when the thickness increases to a predetermined second value.

The thickness of the felt may be monitored by a roller so mounted as to be bodily movable, the extent of the  
20 movement characterising the thickness of the felt. The roller co-operates with another surface which may be that of another roller and which provides a datum for the movable roller.

Alternatively, thickness changes may be determined  
25 by a movable probe whose movement from a datum characterises the thickness of the felt. The movable probe may be of shoe like form with a smoothly-rounded sole to avoid damage to the felt or material thereon or it may be of calliper-like form with suitably shaped surfaces, again to avoid damage to  
30 the felt.

Where the felt thickness is monitored, it is essential to position the monitoring means at a position along the length of the belt where the layer is not conveying material.

- 35 The needle jet shower is conventionally oscillated

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at a speed not related to the rate of movement of the felt. It is found that if the time cycle is short, uneven bulking of the felt results, and thus a further feature of the invention is that the speed of oscillation should be one jet  
5 width per felt revolution to prevent cross-overs and to provide even effect. As felt lengths are variable due to manufacturing tolerances, tension and time of life, and also due to speed, a signal can be taken either from the tensioner position and speed monitor, or a metal thread or other  
10 detectable insert in the felt. This signal is then used to control the cycle time of the oscillating shower. An override is also incorporated in the control panel so that when the minimum vacuum level is reached the shower will continue to operate to the end of its stroke thus ensuring full and  
15 even coverage.

According to the present invention, apparatus for cleaning and/or reconditioning the surface of a press felt includes at least one set of spraying apparatus for directing jets of cleaning and/or reconditioning liquid on to the  
20 surface of the press felt, and means for monitoring the permeability of the press felt for controlling the action of the or each set of spraying apparatus.

The means may comprise at least one vacuum chamber over which the press felt passes in such manner that air can  
25 be drawn through the press felt into the chamber in order to detect the extent of the permeability of the felt.

The vacuum chamber may be additional to the vacuum box used to extract water from the felt and which forms a conventional feature of existing paper and board machines or  
30 where possible, or as explained above, the vacuum level in the vacuum box may be used.

Alternatively, monitoring of the permeability may be effected by a device that is responsive to the thickness of the felt. Such a device initiates operation of the or each  
35 set of spraying apparatus when the thickness reaches a pre-

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determined value and terminates the operation when the thickness reaches a higher predetermined value.

The device may incorporate a roller whose bodily movement characterises the thickness of the felt or it may  
5 comprise probes or a suitable form of calliper.

The means may be so arranged that the or each set of spraying apparatus is brought into use on detection of a predetermined permeability condition of the felt and use of the apparatus terminated when another predetermined permea-  
10 bility condition is detected.

The or each set of spraying apparatus may be brought into use by the opening of a flow control valve to admit cleaning and/or treatment liquid to the apparatus and/or by the energisation of a pump whose output supplies high  
15 pressure cleaning and/or treatment liquid to the apparatus.

In addition, where the spraying apparatus incorporates reciprocating spray jets, the reciprocating machinery may also be brought into operation, when required, by the means.

20 The press felt may be of a compressible felt construction or it may be of the so-called non-compressible felt construction, the latter being, in practice, compressible to a limited extent.

By way of example only, embodiments of the invention  
25 will now be described in greater detail with reference to the accompanying drawings of which:-

Fig. 1 shows a first embodiment in diagrammatic form only,

Fig. 2 shows in schematic form a pneumatic control  
30 system for use with the embodiment of Fig. 1,

Fig. 3 shows a schematic form part of an alternative embodiment of the invention, and

Fig. 4 is an explanatory drawing.

Referring first to Fig. 1, a felt 1 in the form of a  
35 closed loop passes between the nip of rollers 2, 3 which form

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part of the press section of a paper making machine, over an idler roller 4 to a position adjacent to shower apparatus 5 which, when in use, directs a series of jets of water under high pressure, for example,  $35 \text{ Kg/cm}^2$ , towards the surface of the felt 1. Paper material 1a undergoing processing leaves the felt 1 after passing through between the rollers 2, 3 as indicated in the drawing.

A low pressure shower 6 is used to spray water into the felt to ensure, in conjunction with a closely-adjacent turning roller 7, substantial saturation of the press felt. The felt then passes over a conventional vacuum box 8. The box has a support which supports the felt as it passes over the box. The box 8 is connected to a vacuum pump 9 to establish a partial vacuum therein.

The extent of the partial vacuum in the box 8 is conveyed via line 10 to control apparatus shown as block 11 which is adapted to control the operation of the shower apparatus 5 in dependence upon the vacuum conditions existing in the box 8 and the speed of the felt.

The control apparatus also receives an input from a sensor indicated diagrammatically at 12 responsive to the movement of the felt and which acts to signal to the apparatus each complete revolution of the felt.

Tension in the felt is maintained by tensioning means 13 of any conventional form whilst turning rollers 14 and 16 guide the felt back to the nip of the rollers 2 and 3. Between the turning rollers is an alignment roller 15 which keeps the press felt in alignment with the rollers 14 and 16.

When new or after reconditioning, the felt may have a thickness typically of say 4-6 mm but during use this reduces and may reach a value as low as 1 mm.

When in its new condition, the felt, in passing over the vacuum chambers, sets up a partial vacuum therein of say 0.05 M Hg and this is insufficient to bring the shower

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apparatus 5 into operation. However, when the felt has been compressed to a thickness of say 2 mm, the partial vacuum has changed to, say 0.40 M Hg and this brings the shower apparatus into use.

5           The action of the jets of water is to recondition the felt and the latter increases in thickness as it leaves the vicinity of the shower apparatus. Although there is a degree of compression of the felt as it next passes through the nip of the rollers 2, 3, there is a further recondition-  
10 ing effected by the shower apparatus and this continues until the partial vacuum conditions in the box 8 reach a value indicating that a desired reconditioning has been achieved and the control apparatus 11 then terminates the shower.

The cycle repeats when next the degree of compression  
15 of the felt reaches a value at which the control apparatus 11 initiates the shower again.

Fig. 2 shows in diagrammatic form only a high pressure needle jet shower 17 which may be of the form described in European Patent Specification No. 0009399 (Application  
20 No. 79.301942.3). Shower 17 is powered by a pneumatic motor indicated by block 18 fed with compressed air via control line 19.

Fig. 2 also shows the vacuum box 8 and the vacuum pump 9 and although Fig. 2 shows those components in close  
25 proximity to shower 17, this is not normally the case in practice. The vacuum inside box 8 is communicated to control apparatus via line 20, a filter 21 being included to prevent the transmission along the line 20 of any contaminants that may be present.

30           Line 20 is connected to a sensor 21 comprising a housing with an internal chamber divided into two parts by a flexible diaphragm 22, line 20 being connected to one of the chamber parts. The diaphragm is resiliently-loaded as indicated diagrammatically by spring 23 and the loading is  
35 adjustable via a manual control 24.

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In practice, the diaphragm 22 may be spring loaded or it may be loaded by means of a variable pneumatic pressure.

Linked to the diaphragm 22 is a pneumatic control valve 25 adapted to join an outlet line 26 either to atmosphere at outlet 27 or to a source of compressed air via inlet 28.

Line 26 is joined to a first actuator of another pneumatic control valve 29 operable to connect line 19 either to atmosphere at outlet 30 or to a connecting line 31.

Also connected to line 20 is a second sensor 32 whose construction is similar to that of sensor 21 except that the diaphragm loading is preset by means of control 33 and once preset is not normally adjusted by the user. The diaphragm 15 is pneumatically loaded.

Linked to the diaphragm of sensor 32 is a pneumatic control valve 34 movable to connect output line 35 either to atmosphere at outlet 36 or to the source of compressed air via input 37.

Line 35 is joined to a device 38 for emitting a visual warning. Device 38 may comprise an electric light connectable to a power source (not shown) by means of a pressure responsive switch (not shown) that is controlled by pressure changes in line 35.

Line 35 is also connected to a reservoir valve 39 having a throttled outlet 40 to atmosphere, and a first output 41 joined directly to a pneumatic actuator 42 for control valve 43. The actuator 42 operates against a spring bias 44. Control valve 43 is adapted to connect output line 45 either to the source of compressed air via inlet 46 or to atmosphere via outlet 47. Reservoir valve 39 also has a second outlet 48 connected to actuator 42 via adjustable throttles 49, 50.

Output line 45 is connected to a klaxon 51 which provides, as will be described later, an audible warning in

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the event that the vacuum in the box 8 reaches a very high value.

Flow line 20 is also joined to a further sensor 52 whose construction is identical to that of sensor 21. Sensor 52 operates a pneumatic flow control valve 53 connected to join an output line 54 either to atmosphere via outlet 55 or to the source of compressed air via inlet 56.

Output line 54 is joined to a second actuator of the control valve 29 as shown.

Flow line 20 is also joined to yet another sensor 57 whose construction is the same as that of sensor 32 and which controls the operation of flow valve 58. Flow valve 58 is connected to join an output line 59 either to atmosphere at outlet 60 or to the source of compressed air at 61.

Output line 59 is connected to actuate a visual warning light 62 and also to actuate another flow control valve 63 connected in the line 31 to valve 29.

Valve 63 is adapted to connect line 31 either to atmosphere at outlet 64 or to line 65 itself connected to a main manually-operated flow control valve 66. Valve 66 has a control knob 67 rotation of which against the biasing of a spring 68 opens the valve to connect line 65 to the source of compressed air shown as box 69 and which may be a compressor or some other source of compressed air or to atmosphere at outlet 70.

Sensor 21 is loaded to a value determined by the working conditions and the nature of the felt in use to connect line 26 to source 28 when the vacuum conditions in box 8 reach a high value indicating that the felt has compacted to an extent sufficient to effect deleteriously the extraction of liquid therefrom. The application of pneumatic pressure to line 26 causes the first actuator of valve 29 to connect line 19 to line 31 and on the assumption that valves 63 and 66 are in the positions shown pneumatic pressure will be applied to line 19 and this will initiate operation

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of the high pressure shower 17.

As the spray operates, it rebulks the felt and the vacuum in box 8 drops to a value at which sensor 21 releases and sensor 55 responds. The second actuator of valve 29 is 5 pressurised at the first connected to atmosphere via line 26 and valve 25. The position of valve 29 changes and line 19 is connected to atmosphere and the spraying operation at shower 17 is terminated.

This process repeats as the permeability conditions 10 of the felt require.

If, for some reason, the vacuum in box 9 continues to rise above the value to which sensor 21 is set, sensor 32 will respond and valve 34 will cause pneumatic pressure to be applied to line 35 thus energising warning light 38 and 15 causing klaxon 51 to sound via the conventional energising circuit described above. The on-off periods of the klaxon are determined by the settings of the variable throttles 49, 50.

Similarly, if the vacuum pressure in box 8 continues 20 to drop below the value at which sensor 55 responds, sensor 57 will then respond and via valve 58, warning light 62 will be energised.

The manual control knobs of sensors 21 and 52 are mounted upon the front of control box 11 so that they can 25 be set by a user. A pneumatic gauge 71 is also mounted upon the front of the control box to enable the user to make the appropriate adjustments to the setting of the sensors 21 and 52.

A second pneumatic gauge 72 is located within the 30 control box close to the preset controls for the sensors 32 and 57 so that the latter can be preset to the desired values. It will be appreciated that gauge 71 may not be visible during the setting of sensors 32 and 57.

A further warning light 73 indicates when the manually 35 operated valve 66 is actuated to its "ON" position

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allowing air under pressure into line 65.

Fig. 3 shows in diagrammatic form a form of device for sensing the thickness of the felt shown at 1. A calliper-like frame 74 supports probes in the form of shoes 5 75, 76 whose rounded surfaces lightly contact the upper and lower surfaces respectively of the felt 1. At least the upper shoe is lightly spring-loaded to enable it to follow variations in the thickness of the felt 1.

Shoe 75 is movable vertically in the calliper and 10 its movement is sensed by a sensor 77 whose output 78 is used, in a manner similar to that of the sensors 21 and 52 to initiate and terminate operation of the high pressure spray.

Suitable safeguards are provided to sense excessive 15 compaction of the felt also excessive "re-bulking" and these safeguards operate in a manner analogous to those described above with reference to Fig. 2.

If desired, the shoes can be traversed cyclically across the width of the felt. Such movement may be achieved 20 in any convenient manner, for example by a pneumatic or electric motor or by a piston-cylinder arrangement. This is indicated diagrammatically in Fig. 3 by the dotted rectangle 79.

It is possible to traverse the high pressure spray 25 in synchronism with the shoes.

The use of relatively small area shoes makes it possible to detect localised areas of web compaction. For example, and as shown in Fig. 4, the web 1 may have reached a condition in which a longitudinal area 80 exists over 30 which a relatively high degree of compaction of the felt exists and another longitudinal area 81 over which a relatively low degree of compaction exists.

If the vacuum box technique described above is used, the box 8 being shown in Fig. 4, the existence of the areas 35 80 and 81 would probably remain undetected but a shoe, shown

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at 82 in Fig. 4, moving across the felt will detect the areas and bring the spray into operation as necessary to "re-bulk" area 80.

- 5 Reference has been made above to the stopping of the spray only at the end of a cycle of movement. This may be achieved in a number of ways, for example a control line 83 shown dotted in Fig. 2 is used to control a valve 84 in line 54 which prevents energisation of the second actuator of valve 29.



## Claims:

1. A method of maintaining the permeability of felts in paper board and like machines comprising the steps of monitoring the permeability of the felt, and bringing into operation apparatus for directing at the felt a spray  
5 of liquid for reconditioning the felt, when the monitored permeability reaches a first predetermined value and terminating the operation of the apparatus when the permeability reaches another, second predetermined value higher than the first value.
- 10 2. A method as claimed in claim 1 in which the permeability of the felt is monitored by means responsive to the degree of vacuum applied to the felt.
3. A method as claimed in claim 2 in which the degree of vacuum is that applied to the felt to extract  
15 water therefrom.
4. A method as claimed in claim 1 in which the permeability is monitored by assessing changes in the thickness of the felt.
5. A method as claimed in claim 1 which further  
20 includes the steps of sensing the speed of the felt passed the apparatus and of using the sensed value to determine the spray cycle time of the apparatus.
6. A method as claimed in claim 5 in which the operation of the apparatus is terminated only at the end of  
25 a spray cycle.
7. A method as claimed in claim 6 in which the apparatus completes a movement equal to one jet diameter for each revolution of the felt.
8. Apparatus for maintaining the permeability of  
30 paper and board machine felts comprising shower means for directing at the felt a spray of liquid for reconditioning the felt, means for monitoring the permeability of the felt and a control device responsive to the output of said sensing means to bring the shower means into operation when the  
35 monitored permeability reaches a first predetermined value



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and to terminate the operation of the shower means when the monitored permeability reaches a second predetermined value higher than the first value.

9. Apparatus as claimed in claim 8 and further  
5 comprising a vacuum-operated, device for applying a vacuum to the felt, and in which the monitoring means is such as to respond to the degree of vacuum in a vacuum chamber of the device.

10. Apparatus as claimed in claim 8 and further  
10 comprising a vacuum-operated, liquid extraction device for removing liquid from the felt, and in which the monitoring means is such as to respond to the degree of vacuum in a vacuum chamber of the device.

11. Apparatus as claimed in claim 8 in which there  
15 is provided a device responsive to changes in the thickness of the felt for monitoring the changes in the permeability thereof.

12. Apparatus as claimed in claim 3 in which the  
shower means includes a series of spaced spray jets and an  
20 arrangement for reciprocating the spray jets across the width of the felt, and in which there is included means responsive to the speed of the felt and whose output is used to control the cycle time of the said arrangement.

13. Apparatus as claimed in claim 12 in which the  
25 control device terminates the operation of the spray means when the monitored permeability reaches the second value and when the spray jets are at the end of a cycle of movement.

14. A paper, board or sheet making machine incorporating apparatus as claimed in claim 8.





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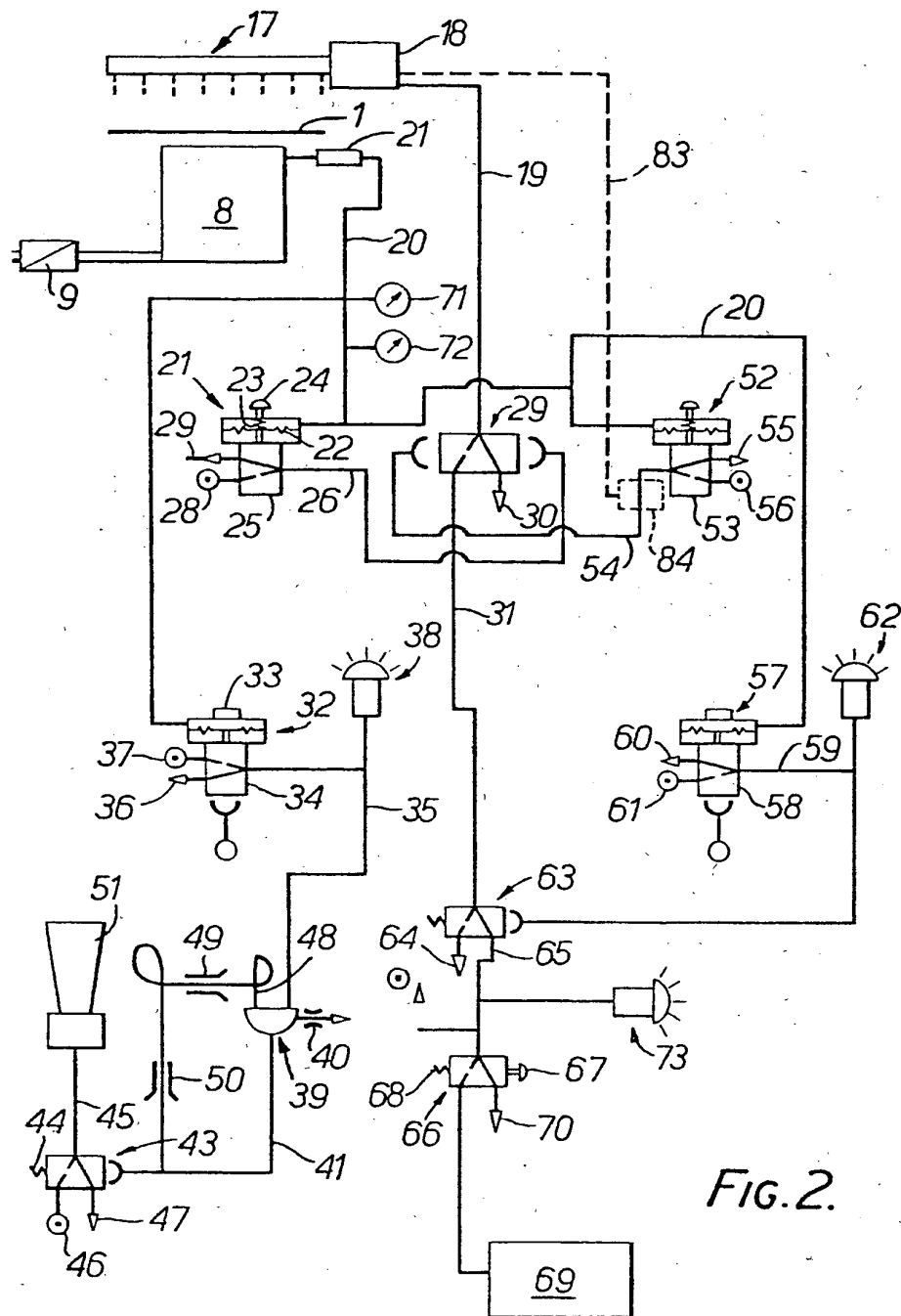


FIG. 2.

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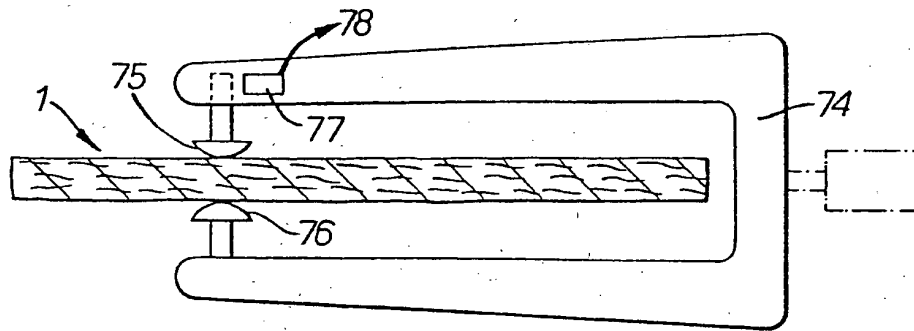


FIG. 3.

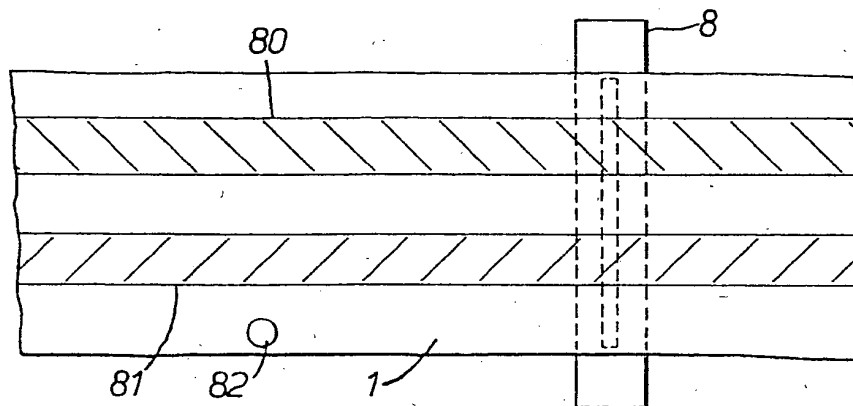


FIG. 4.



European Patent  
Office

# EUROPEAN SEARCH REPORT

0024205

Application number  
EP 80 30 2805

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	US - A - 3 859 163 (HAYTHORNTH-WAITE) * Whole document *	1-3,8-10	D 21 F 1/32
	FR - A - 2 265 910 (WESTVACO) * Page 9, lines 2-34 *	5,7,12	
			TECHNICAL FIELDS SEARCHED (Int. Cl.)
			D 21 F
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document
The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
The Hague	19-11-1980	DE RIJCK	



(19)



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## PATENT ABSTRACTS OF JAPAN

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SUYAMA TORU(54) AUTOMATIC CLEANING APPARATUS FOR  
ENDLESS PAPER-MAKING TOOL

## (57) Abstract:

**PURPOSE:** To save the consumption of cleaning liquid by detecting the lateral position of the stain of an endless paper-making tool and spraying cleaning liquid exclusively to the lateral position or thereabout.

**CONSTITUTION:** The pressure in a section chamber 6 positioned just below a non-stained part of a paper-making tool 1 is close to atmospheric pressure, while the pressure in a section chamber just below a stained part is decreased and the vacuum degree is increased by the clogging action of the stained part. The pressure variation in the section chamber is converted to an electric signal by a piezoelectric transducer 9 and inputted into a controller 10. A nozzle 11 is laterally transferred to the position corresponding to the section chamber having increased vacuum degree and cleaning liquid is sprayed to the part.

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